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EXAMINER	
MOORE JR, MICHAEL J	

ART UNIT	PAPER NUMBER
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/749,332	Applicant(s) BALAKRISHNAN ET AL.	
	Examiner Michael J. Moore, Jr.	Art Unit 2666	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 December 2000*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10,12-17,19,21-25 and 27-30* is/are rejected.

7)☒ Claim(s) *11,18,20 and 26* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *27 December 2000* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ ~~Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)~~ Paper No(s)/Mail Date *5*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Information Disclosure Statement

1. The information disclosure statement (IDS) submitted on 3/21/2001 is in compliance with the provisions of 37 CFR 1.97. Accordingly, the examiner has considered the information disclosure statement.

Drawings

2. The drawings are objected to because of the following informalities. It is suggested that formal drawings be submitted as the present drawings contain handwritten elements. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Objections

3. Claims **2-4, 12, 16, 17, 19, and 26** are objected to because of the following informalities:

Regarding claim **2**, on line 3, the word "the" before word "availability" should be "an".

Regarding claim **3**, on line 6, the word "the" before word "signal" is not needed.

Regarding claim **4**, on line 3, the word "the" before word "highest" should be "a".

Regarding claim **12**, on line 3, the word "the" before word "status" should be "a".

Regarding claim **16**, on line 2, the word "the" before word "energy" should be "an".

Regarding claim **17**, there is some confusion as to the wording on lines 4-5 ("transmitting the data from each cluster-head to the base station during the first transmission round"). It is suggested this be changed to "each cluster-head transmits data to the base station during the first transmission round".

Regarding claim **19**, on line 2, the word "the" before word "second" should be "a". Also, on lines 3-4, it is believed that the phrase "the respective cluster nodes" should be "the respective cluster-heads".

Regarding claim **26**, on line 5, the word "the" before word "number" should be "a".

Appropriate correction is required.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims **1-4, 10, 12-15, 17, 19, 21, 24, 25, and 27-30** are rejected under 35 U.S.C. 102(b) as being anticipated by Ramanathan (U.S. 5,850,592). Ramanathan teaches all of the limitations of the listed claims with the reasoning that follows.

Regarding claim **1**, "a method of forming a network from a plurality of nodes and a base station" is anticipated by the method described in Figure 2. A station entering operation as a cluster gateway spoken of on column 4, lines 9-10, anticipates "Identifying at least one node of the plurality of nodes to operate as a cluster-head". "Forming a plurality of clusters from the plurality of nodes, each of the clusters having at least one cluster-head" is anticipated by the network shown in Figure 1 composed of cluster gateway stations 11-15 (cluster-heads) as well as non-cluster head nodes 30. "Transmitting data from at least one node in at least one of the plurality of clusters to the cluster-head in that cluster" is anticipated by an affiliation request message sent from a station to a gateway station spoken of on column 5, lines 1-4. "Transmitting data from at least one cluster-head to the base station" is anticipated by the exchanging of messages by the cluster gateway stations spoken of on column 4, lines 30-34. Lastly, "identifying a different one of the plurality of nodes to operate as a cluster-head" is anticipated by a station entering operation as a cluster gateway spoken of on column 4, lines 9-10.

Regarding claim **2**, "advertising the availability of each of the plurality of cluster-heads" is anticipated by the broadcast of beacon messages by cluster gateways, which

establish presence and availability as spoken of on column 4, lines 12-16. Lastly, "establishing a communication path between each of the plurality of cluster-heads and at least one of the plurality of nodes, not operating as a cluster-head, to form a cluster" is anticipated by the data communication links shown in Figure 1 that connect cluster gateway stations as well as non-cluster gateway stations.

Regarding claim **3**, "transmitting a status signal from each one of the plurality of cluster-heads" as well as "receiving at each of the plurality of nodes one or more of the status signals" is anticipated by the broadcast of beacon messages (status signals) by cluster gateways, which establish presence and availability as spoken of on column 4, lines 12-16. "Comparing, at each of the plurality of nodes, not operating as a cluster-head, signal strengths of the received one or more status signals" is anticipated by the collecting of gateway station beacons by a station and the forming of an ordered list of preferred gateway stations based upon signal strength as spoken of on column 4, lines 50-67. Lastly, "joining a particular one of the cluster-head's cluster as a result of the comparison" is anticipated by the affiliation confirmation sent by a member station spoken of on column 5, lines 1-10.

Regarding claim **4**, "wherein the step of joining a particular cluster is based on a determination, by at least one of the plurality of nodes, of the cluster-head transmitting the status signal having a highest received signal strength" is anticipated by the forming of an ordered list of gateway stations ordered from most powerful signal strength to the least as spoken of on column 4, lines 50-67.

Regarding claim **10**, "the step of randomly selecting one of the plurality of nodes to be a cluster-head" is anticipated by a station entering operation as a cluster gateway upon failure of an affiliation procedure that is performed with a random delay as spoken of on column 3, lines 34-45 as well as column 4, lines 8-10.

Regarding claim **12**, "collecting data on the status of each of the plurality of nodes" is anticipated by the collecting of gateway station beacons by a station as spoken of on column 4, lines 50-67. Lastly, "assigning each of the plurality of nodes to a particular one of a plurality of clusters" is anticipated by the affiliation confirmation sent by a member station spoken of on column 5, lines 1-10.

Regarding claim **13**, "a method for forming a network from a base station and a plurality of nodes" is anticipated by the method described in Figure 2. A station entering operation as a cluster gateway spoken of on column 4, lines 9-10, anticipates "electing a cluster-head from the plurality of nodes". "Establishing a communication path between first ones of the plurality of nodes and the cluster-head to form a cluster" is anticipated by the data communication links shown in Figure 1 that connect cluster gateway stations as well as non-cluster gateway stations. "Establishing a first round of data transmission" is anticipated by the station affiliation procedure spoken of on column 3, lines 35-45. "Transmitting from the first ones of the plurality of nodes to the cluster-head during the first data transmission round" is anticipated by an affiliation request message sent from a station to a gateway station spoken of on column 5, lines 1-4. Lastly, "transmitting data from the cluster-head to the base station during the first

data transmission round" is anticipated by the exchanging of messages by the cluster gateway stations spoken of on column 4, lines 30-34.

Regarding claim **14**, "electing a plurality of cluster-heads corresponding to a first set of cluster-heads for use during the first round of data transmission" is anticipated by a station entering operation as a cluster gateway spoken of on column 4, lines 9-10. Lastly, "establishing a communication path between each of the plurality of cluster-heads and at least one node of the plurality of nodes to form a first plurality of clusters" is anticipated by the data communication links shown in Figure 1 that connect cluster gateway stations as well as non-cluster gateway stations.

Regarding claim **15**, a station (base station) entering operation as a cluster gateway spoken of on column 4, lines 9-10, anticipates "wherein the step of electing a plurality of cluster-heads is performed by the base station".

Regarding claim **17**, "during the first round of data transmission, each of the at least one node in each cluster transmits data to the cluster-head of that cluster" is anticipated by an affiliation request message sent from a station to a gateway station spoken of on column 5, lines 1-4. Lastly, "transmitting the data from each cluster-head to the base station during the first transmission round" is anticipated by the exchanging of messages by the cluster gateway stations spoken of on column 4, lines 30-34.

Regarding claim **19**, "transmitting data from each node in the second set of clusters to the respective cluster nodes" is anticipated by an affiliation request message sent from a station to a gateway station spoken of on column 5, lines 1-4. Lastly, "transmitting data from each of the second set of cluster-heads to the base station" is

anticipated by the exchanging of messages by the cluster gateway stations spoken of on column 4, lines 30-34.

Regarding claim **21**, "a network comprising a base station and a plurality of nodes" is anticipated by the network shown in Figure 1. "A cluster-head selector processor" as well as "a cluster selector processor" are anticipated by the embedded microprocessor of each station used for controlling mode of operation as spoken of on column 3, lines 21-27. Lastly, "each cluster comprised of a subset of the plurality of nodes, and one of each of the subset of the plurality of nodes temporarily acting as a cluster-head" is anticipated by the data communication links shown in Figure 1 that connect cluster gateway stations as well as non-cluster gateway stations into a plurality of clusters with corresponding cluster-heads as spoken of on column 3, lines 1-27.

Regarding claim **24**, "wherein each of the plurality of nodes further comprises an adjustable transmission energy level" is anticipated by each station transmitting at either a high or low power level as spoken of on column 2, lines 55-67.

Regarding claim **25**, "wherein each of the plurality of nodes further comprises a low energy mode, and a high energy mode" is anticipated by each station transmitting at either a high or low power level as spoken of on column 2, lines 55-67.

Regarding claim **27**, "wherein each of the plurality of nodes further comprises a signal strength processor" is anticipated by the testing of proximity conditions to other gateway stations by signal strength measurements (processing) performed by each gateway station as spoken of on column 4, lines 30-34.

Regarding claim **28**, "wherein the cluster selector processor determines the cluster selection in response to a signal from the signal strength processor" is anticipated by the affiliation confirmation sent by a member station spoken of on column 5, lines 1-10 based upon the collecting of gateway station beacons (signals) by a station and the forming of an ordered list of preferred gateway stations based upon signal strength as spoken of on column 4, lines 50-67.

Regarding claim **29**, "wherein the base station selects each of the plurality of nodes to temporarily act as a cluster-head" is anticipated by a station (base station) entering operation (selects itself) as a cluster gateway spoken of on column 4, lines 9-10.

Regarding claim **30**, "wherein the base station determines which of each of the plurality of nodes is included in each temporary cluster" is anticipated by the maintained data structure indicating the present constituency of the network performed by gateway stations (base stations) as spoken of on column 4, lines 16-22.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein

were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claims **5-9** are rejected under 35 U.S.C. 103(a) as being unpatentable over Ramanathan (U.S. 5,850,592) in view of Gelvin et al. (U.S. 6,735,630).

Regarding claims **5 and 8**, Ramanathan teaches the method of claim **2**. Ramanathan fails to explicitly teach generating a schedule at the cluster-head having allotted slots for transmission and using these slots for transmission from a node to a cluster-head. However, Gelvin et al. teaches a sensor network self-organization method in Figure 5 that makes use of TDMA scheduling for data transmission between stations as spoken of on column 4, lines 40-66. At the time of the invention, it would have been obvious to someone of ordinary skill in the art given these references to use the TDMA scheduling of Gelvin et al. with the method of Ramanathan in order to reduce station power consumption by ensuring stations are turned off as much as possible as spoken of on column 4, lines 42-47 of the Gelvin et al. reference.

Regarding claim **6**, Ramanathan also fails to teach the step of reducing the data transmission latency by using application-specific data aggregation to reduce the amount of redundant data sent to the base station. However, Gelvin et al. teaches the use of beamforming (aggregation) to enable suppression of interfering sources as spoken of on column 19, line 58 – column 20, line 4. At the time of the invention, it

would have been obvious to someone of ordinary skill in the art given these references to make use of the beamforming of Gelvin et al. with the method of Ramanathan in order to achieve more precise position estimates as stated on column 19, lines 58-60 of the Gelvin et al. reference.

Regarding claim **7**, Ramanathan also fails to teach the step of increasing the signal to noise ratio of the data sent to the base station by using application-specific data aggregation. However, Gelvin et al. teaches the use of beamforming (aggregation) to yield processed data with a higher signal to noise ratio as spoken of on column 19, line 58 – column 20, line 4. At the time of the invention, it would have been obvious to someone of ordinary skill in the art given these references to make use of the beamforming of Gelvin et al. with the method of Ramanathan in order to achieve more precise position estimates as stated on column 19, lines 58-60 of the Gelvin et al. reference.

Regarding claim **9**, Ramanathan also fails to teach the step of beamforming the data received from the plurality of nodes in the cluster. However, Gelvin et al. teaches the use of beamforming (aggregation) as spoken of on column 19, line 58 – column 20, line 4. At the time of the invention, it would have been obvious to someone of ordinary skill in the art given these references to make use of the beamforming of Gelvin et al. with the method of Ramanathan in order to achieve more precise position estimates as stated on column 19, lines 58-60 of the Gelvin et al. reference.

9. Claim **16** is rejected under 35 U.S.C. 103(a) as being unpatentable over Ramanathan (U.S. 5,850,592) in view of reference "A" (Estrin et al.) labeled on PTO-1449.

Ramanathan teaches the method of claim **15**. Ramanathan fails to teach where cluster-heads are elected by minimizing energy required during the first round of data transmission. However, reference "A" on PTO-1449 teaches cluster-head election by sensors taking turns being cluster-head based on their current energy level. At the time of the invention, it would have been obvious to someone of ordinary skill in the art given these references to use the election method of reference "A" with the method of Ramanathan in order to achieve more efficient energy usage as stated on page 266, lines 32-36.

10. Claims **22 and 23** are rejected under 35 U.S.C. 103(a) as being unpatentable over Ramanathan (U.S. 5,850,592) in view of reference "B" (Clare et al.) labeled on PTO-1449.

Regarding claim **22**, Ramanathan teaches the network of claim **21**. Ramanathan fails to teach each of the plurality of nodes in communication with a sensor. However, reference "B" on PTO-1449 teaches the use of self-organizing microsensor networks that have distributed sensor nodes. At the time of the invention, it would have been obvious to someone of ordinary skill in the art given these references to modify the network of Ramanathan to the microsensor network of reference "B" in order to provide a means for sensing the current environment and informing users as stated on page 229, lines 21-22 of reference "B".

Regarding claim **23**, Ramanathan teaches the network of claim **21**. Ramanathan fails to teach each of the plurality of nodes having a sleep mode. However, reference "B" on PTO-1449 teaches the turning off of a node receiver (sleep mode) upon detection of lack of data during an assigned slot. At the time of the invention, it would have been obvious to someone of ordinary skill in the art given these references to use the sleep mode teaching of reference "B" with the teachings of Ramanathan in order to provide node energy conservation as stated on page 232, lines 12-14 of reference "B".

Allowable Subject Matter

11. Claims **11, 18, 20, and 26** are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

12. The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim **11**, the prior art of record teaches the method of claim **10**. The prior art of record fails to teach randomly selecting a cluster-head from a plurality of nodes based upon a probabilistic function of an amount of energy remaining in each of the plurality of nodes.

Regarding claim **18**, the prior art of record teaches the method of claim **14**. The prior art of record fails to teach determining whether each node has been a cluster-head, electing a second set of cluster-heads including nodes that were never cluster-heads previously, and forming a second set of clusters about these cluster-heads.

Regarding claim **20**, the prior art of record teaches the method of claim **14**. The prior art of record fails to teach determining remaining energy in each node, electing a second set of cluster-heads based on remaining energy in these nodes, and forming a second set of clusters about these cluster-heads.

Regarding claim **26**, the prior art of record teaches the network of claim **21**. The prior art of record fails to teach the cluster-head selector processor selecting each cluster-head based on remaining energy in each node as well as the number of times each node has previously operated as a cluster-head.

Conclusion

13. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Haas (U.S. 6,304,556), Parkhideh (U.S. 5,946,317), and Dowling (U.S. 6,636,499) are all references that contain material pertinent to this application.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael J. Moore, Jr. whose telephone number is (571) 272-3168. The examiner can normally be reached on Monday-Friday (8:30am - 5:00pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Seema S. Rao can be reached at (571) 272-3174. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Michael J. Moore, Jr.
Examiner
Art Unit 2666

mjm MM

FRANK DUONG
PRIMARY EXAMINER